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Educational Television Series 1968-69

Teachers' Guide

Business and Commerce

Data Processing INTERMEDIATE AND SENIOR

Educational Television Branch
ONTARIO DEPARTMENT OF EDUCATION
1670 Bayview Avenue, Toronto 17

BUSINESS & COMMERCE

DATA PROCESSING

A series of 10 programs of 20 minutes each for students in grade 10 with general interest for grades 11 and 12.

These programs are repeated from the 1967-68 series.

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GENERAL INTRODUCTION

This series of ETV programs is a presentation of the introductory course in Data Processing, and is designed to reinforce the classroom teaching of this new and fascinating subject. While planned primarily for the Grade 10 level, following closely Curriculum RP-33, the series should be of interest and benefit to any grade studying data processing for the first time.

Throughout the series, emphasis has been placed on:

a. Man's need to process data (information).

b. The development of newer and faster methods as the need arises.

c. The evolution of modern data processing systems based upon the contributions of the past.

The information given in the series is intended to present those parts of the course which lend themselves to visual presentation and which would be difficult for the teacher to present without searching through vast sources of reference and visual material.

It is felt that the series will add an additional dimension to the students' understanding of data processing by presenting television visits to actual business establishments.

Many of today's great achievements, such as the space programs, would not have been possible without the assistance of modern, high-speed data processing systems. The television series will show the subject as an important preparation for future life.

PROGRAM 1

THE INFORMATION EXPLOSION

The purpose of this program is to provide a study of the background and historical development of data processing methods and devices. Its secondary purpose is to develop an appreciation of the need for modern data processing equipment.

PROGRAM CONTENT

This first program briefly traces the historical development of data processing aids from ancient times, through the dark ages and the Renaissance period, the Industrial Revolution, up to the present day with its high-speed electronic systems.

The program points out that data processing always involves some sort of input, some way of storing or remembering of information, a control, processing and output. With this in mind, it traces down through history some of the increasingly complicated ways in which man has "data processed" information. Commencing with finger-counting, the program refers to sand and pebble trays, the abacus, the Hindu and Arabic numbering systems and Stonehenge.

Gutenberg's invention of the printing press, together with the Renaissance opened a new phase in the life and growth of Western Europe. In the area of commerce and business, new needs arose which resulted in advances in methods of data processing. The program refers particularly to Blaise Pascal's invention of the numerical wheel calculator and to Charles Babbage's *Difference Engine* and *Analytical Engine.* The latter, known as "Babbage's Folly", failed because contemporary technology was unable to cope with it, nor did the need for such a machine yet exist. In developing his *Analytical Engine,* Babbage incorporated the principle of punched cards, invented by Jacquard for his looms. In turn, the *Harvard Mark 1,* put into service in 1944, is based on principles used by Babbage in his engine. Thus, most inventions and advances incorporate ideas previously worked out by some other person.

The program concludes with a reference to the tidal wave of information which is now engulfing the world and points out that any data processing machine developed can be no greater than the men who design the system and program the information.

POINTS OF EMPHASIS

1. Each new development has been in response to a need.

2. Each new development has been based upon the knowledge and contributions of the past.

3. Mounting volumes of paper work and repetitive tasks have brought about the need for mechanical aids, from the comparatively simple adding machine, to the complex, high-speed electronic equipment.

SUGGESTED PRE-VIEWING ACTIVITIES

If not already covered in class, students could present reports on the principles of the sand and pebble tray, the abacus, Stonehenge, and other "data processing"

devices used by man in his earlier stages of development.

SUGGESTED POST-VIEWING ACTIVITIES

1. Students may be interested in conducting more detailed research into some of the inventions mentioned on the program — *Jacquard's Loom, Babbage's Engines, Pascal's Wheel Calculator, the Harvard Mark 1.*
2. Discuss the idea that each development in data processing has been in response to a need.

Bibliography

Life Science Library, Mathematics, Chapter 1, Time Inc., New York

PROGRAM 2

INPUT TO OUTPUT

This program introduces the five factors that are present in any data processing system — past or present, small or large — namely, INPUT, STORAGE, MANIPULATION, OUTPUT, and CONTROL. The program illustrates the function symbols employed to represent them.

PROGRAM CONTENT

Even though the human brain is still the best machine we have, it is incapable of keeping pace with the information explosion which, by 1970, will result in the sum of human knowledge being increased every five years. However, as needs have altered, new developments have come along to help us cope with these. To illustrate this, the program refers to Charles Dickens' description of the office in *Dombey and Sons,* to William Seward Burroughs' development of the adding machine and to other inventions.

Regardless of volume or complexity, the flow of information involves the same five basic factors. The volume of data transactions (INPUT and STORAGE), and complexity of processing (MANIPULATION), information requirements (OUTPUT), and the overall accuracy of the system (CONTROL), are instrumental in determining the means by which data are processed.

The latter part of the program is devoted to a detailed study of the interrelationship of these factors when applied to a specific problem. Viewers will be taken into a business and shown its operations in terms of these factors.

POINTS OF EMPHASIS

1. The five factors outlined are applicable to any data processing system.
2. The OUTPUT requirements determine the INPUT, STORAGE, and MANIPULATION requirements.
3. The CONTROL factor is concerned with ensuring that all operations are performed, and that the operations are performed accurately and in the proper sequence.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Introduce the five factors of any data processing system using examples that the students may suggest, or with which they are familiar.
2. Use appropriate symbols to represent the various factors, i.e. I.B.M., American Standards Association, etc.
3. The students should be familiar with the use of templates to show chart problems by means of symbols.

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss the interrelationship of the five factors of the example shown on the broadcast.
2. Construct a flow-chart — a series of simple problems using the appropriate INPUT, STORAGE, MANIPULATION, and OUTPUT symbols.
3. Point out the significance of the CONTROL factor with specific reference to the students' flow-chart.
4. Include additional processing steps which would be useful in proving the accuracy of the overall operation.

PROGRAM 3

MANUAL DATA-PROCESSING

The purpose of this program is to demonstrate the processing of information by manual methods, including the use of simple machines and devices.

PROGRAM CONTENT

Manual data processing — a combination of manual methods and simple machines — is still wide-spread. The telecast indicates the variety of business which employs this type of processing, pointing out that the need dictates the best sort of system for the particular business.

The symbols for the five data processing functions are again shown, this time being used in making a block diagram or a flow-chart.

Most of the program is devoted to a survey of the system employed by a relatively small manufacturer of automotive chemicals and detergents. During this filmed visit to the company, the viewer sees the use of the time clock, the writing board, the payroll routine, purchase order sequence, inventory control, sales and billing routines, sales' analysis, edge- and field-punched cards, needle-sort procedure, Telex and spirit duplicator.

POINTS OF EMPHASIS

1. The five basic data processing functions are present in all information handling, regardless of the method employed.
2. Manual methods, which invariably include the use of some devices or aids, are still found adequate in some applications.

SUGGESTED PRE-VIEWING ACTIVITIES

Discuss or, if possible, demonstrate the use of the writing board, edge- and field-punched cards, needle sorting.

SUGGESTED POST-VIEWING ACTIVITIES

Discuss the data processing methods as seen at the Tumbler Laboratories. Does the general procedure followed seem to be the most economical method for the particular situation?

PROGRAM 4

THE BUSINESS MACHINES

The purpose of this program is to demonstrate mechanical methods of data processing as employed in actual business situations.

PROGRAM CONTENT

The program opens with a brief survey of the great range of business machines now on the market, each designed to serve a specific purpose. It has, in fact, become difficult to draw a firm line between machines which are mechanical, electro-mechanical, or which are computers.

Most of the program presents a survey of the data processing operations in a large soft-drink plant where an accounting machine is used which actually acts like a computer. The survey shows the use of requisition and return sheets and magnetic cards in processing the day's sales, preparing a sales analysis and computing details of drivers' sales. It also presents details of payroll procedures at this plant.

POINTS OF EMPHASIS

1. The more sophisticated machines have been developed in response to a need.
2. Many business firms employ mechanical methods of data processing because these are found to be adequate for their particular purposes.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Review the evolution of the business machine, from Pascal's "gears" to the modern desk calculator.
2. Discuss "magnetic cards", with the strip of magnetic tape (on the back) which is used to store information.

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss payroll procedures as seen at Wilson's Ginger Ale, noting that the plant workers are paid on an hourly basis, the drivers are paid a salary plus commission, and the office staff are paid on a weekly basis.
2. Note ways in which the accounting machine acted like a computer.

PROGRAM 5

UNIT RECORD — PART 1

This program illustrates the unit record principle — what the punched hole will do — and introduces the fundamentals of unit record data processing.

PROGRAM CONTENT

The early developments of punched-card equipment are briefly highlighted. These include Jacquard's punched card textile loom, Hollerith's punched card system used to process the 1890 U.S. Census, and a similar system designed by Powers to process the 1910 U.S. Census. The Hollerith and Powers punched cards, commonly referred to today as the IBM and UNIVAC cards, are illustrated.

The five factors of any data processing system are related to unit record data processing systems, and appropriate symbols are used to illustrate these factors.

The preparation of a student directory illustrates the three main factors — recording (input), sorting (manipulation), and printing the directory (output). The storage factor is the card itself, and the control factor is illustrated by means of a wired control panel.

Card design is stressed and two applications — a punched card invoice and a mark sense meter card — serve to illustrate the diverse card formats that can be designed.

POINTS OF EMPHASIS

1. The unit record principle, whereby one transaction is recorded per punched card, and recorded once only, greatly increases the efficiency of data processing operations.
2. Various types of machines are used to process the punched cards in order to satisfy the requirements (factors) of any data processing system.
3. The punched card is a flexible document that can be designed to fulfill not only the input requirements of a system, but also the output requirements, as evident in the increasing popularity of punched card invoices.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Review the fundamentals of unit recording data processing. Include the principles of the unit record, and the functions of the various types of unit record machines.
2. Review the symbols used in systems flow charting, and develop systems flow charts for simple applications.
3. Review the factors involved in card design.

SUGGESTED POST-VIEWING ACTIVITIES

1. Design a source document and a card layout that could be used in a student directory application.
2. Develop systems flow charts, and design source documents, card layouts, and output documents for simple student applications, i.e. — recording student locker numbers, class marks, etc.

PROGRAM 6

UNIT RECORD — PART 2

This program serves two functions. First, it illustrates the steps involved in processing invoicing and associated applications. Second, it points out one of the primary advantages of the unit record itself — the fact that a single transaction affects several related applications.

PROGRAM CONTENT

The series of applications described in this program belong to what is commonly called the invoicing family. In this particular system, a daily inventory check is made to determine whether sufficient stock is available to fill customer orders

which are received each day. At the same time, the inventory balances are updated in order to reflect the various inventory receipts and disbursements transactions.

A combination order-invoice set is then prepared. These documents are used to pick and ship the various items ordered, to invoice the customer for all items shipped, and to provide an accounting record for reference purposes. At the same time the order-invoice set is prepared, an accounts receivable debit transaction is created to be used to update accounts receivable at a later time.

At the end of the month, the sales transaction cards are processed to prepare various sales analysis reports.

A systems flow chart for these applications is developed and illustrates the sequential operations to be performed. The applications are then performed as indicated using the unit record equipment.

POINTS OF EMPHASIS

1. A systems flow chart may appear initially to be very complicated; however, remember that it is a step-by-step procedure to follow in order to prepare a required output. There is a reason why each step must be performed as indicated. Try to determine what the reason is for each step.
2. Note that appropriate symbols are used.
3. There are more unit record installations than computer installations, but the margin is diminishing.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Understand the functions of the various types of unit record equipment.
2. Develop simplified systems flow charts for the more common unit record applications.

SUGGESTED POST-VIEWING ACTIVITIES

1. Review the applications presented in this program and develop systems flow charts for inventory control, invoicing, and sales analysis.
2. Include control steps in each systems flow chart which would verify the accuracy of the output.
3. Develop a systems flow chart for a payroll application.

PROGRAM 7

THE ANATOMY OF A COMPUTER

This program illustrates two physical characteristics which distinguish the electronic computer from other data processing systems. First, the electronic computer stores both instructions and data in electronic devices which permit data movement, arithmetic operations, and logic operations to be performed in millionths and even billionths of a second. Second, all the factors of a data processing system — input, storage, manipulation, output, and control — are integrated within a single unit.

PROGRAM CONTENT

The rapid development of electronic computers from the Harvard Mark I in 1944 to our present computer systems is reviewed. The two major motivating forces are the increasing demand and the many technological advances in electronics.

The five factors of any data processing system are contained within a computer system. Apart from the fact that these factors are integrated within a single system, the computer is unique among all other data processing systems in that the instructions which make up the program to be executed, are stored internally in the computer's memory. The stored program concept provides immense capacity to store instructions, rapid access time to retrieve instructions from storage, the ability to execute instructions that will change other instructions, and a logic unit which gives the impression that the computer is a rational being. *Input* devices such as card readers, punched paper tape readers, magnetic tape drives, magnetic disk drives, console typewriters, and optical scanners are described. The *control* factor is described as consisting partly of the external controls found on the control panel, but is primarily comprised of the internal circuitry required to interpret the instructions stored in memory and to execute each instruction. *Storage* is illustrated in considerable detail. Coding structures, and the difference between character and word storage are described. The *arithmetic* unit and binary arithmetic are also described. *Output* devices such as card punches, paper tape punches, magnetic tape drives, magnetic disk drives, console typewriters, and high-speed printers are illustrated.

The program concludes with a simple demonstration — the preparation of a student directory. A systems flow chart is developed to illustrate the hardware features of the computer that are required, and a procedural flow chart is developed which depicts the sequential operations to be performed in order to print the directory. The program concludes with the preparation of the student directory.

POINTS OF EMPHASIS

1. Instructions as well as data are stored in a binary code in magnetic storage devices.
2. The control unit consists primarily of the internal circuitry which translates and executes the stored instructions.
3. In a computer system, the five factors of a data processing system are integrated within a single unit.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Review number systems and binary arithmetic.
2. Review BCD (Binary Coded Decimal).
3. Develop systems flow charts for computer applications.
4. Develop procedural flow charts for the computer applications above.

SUGGESTED POST-VIEWING ACTIVITIES

1. Develop a diagram to represent the relationship of the five factors of a data processing system.
2. Develop procedural flow charts depicting more difficult problems, such as:

select the largest of three integers per input card and write it on the printer.

Determine the number of passes and failures, and the average mark, in a class of thirty-one students and write these three items using the printer. Each student's mark is punched in an individual card.

PROGRAM 8

COMMUNICATING WITH A COMPUTER

The purpose of this program is to demonstrate some different methods of instructing the computer in what it is to do.

PROGRAM CONTENT

A computer will do only that which it is instructed to do; however, the instructions which a computer executes must be coded in a form that the control unit within the computer system can understand. A code is necessary in order that the instructions shall take up as little storage space as possible. Also a computer operates in binary mode as a result of its electronic nature and instructions may be stored in a binary coded decimal representation or in the form of binary words, depending upon the particular computer. To further complicate matters, the instruction codes vary from computer to computer. Thus, the first concept to grasp when wondering how to communicate with a particular computer system, is that instructions stored in the memory of a computer must conform to the language of that *particular* computer.

There are two approaches to communicating with a computer. The first involves understanding the instruction format and codes which a particular computer uses, writing the instructions you wish the computer to execute in the computer's language, and storing these instructions in the memory unit of the computer. This can be done, but it is awkward, tedious, and very easy to make errors. A portion of this program illustrates machine language instructions.

The other programming approach is to write the instructions that you wish the computer to store in its memory for execution at a later time in a language that is easy for humans to use. This type of language is called a problem-oriented language or symbolic language, and although there are definite rules that must be observed, the objective of such languages is the simplification of the programming effort. COBOL and FORTRAN are popular problem-oriented languages. After a program is written in a problem-oriented language, a program prepared by the computer manufacturer, called a *compiler,* is used to translate the problem-oriented language into the language of the particular machine. The machine-language program can then be read by the computer and stored in memory whenever required. Problem-oriented languages are described and sample statements are illustrated in the middle portion of the program.

The remainder of this program is devoted to simple problems and the COBOL instructions which would be required.

POINTS OF EMPHASIS

1. A computer system has a language of its own. It is very difficult for humans to use such a language.
2. Problem-oriented languages such as COBOL and FORTRAN greatly reduce the programming effort.
3. A problem-oriented language is translated into machine-language by means of a program (compiler) written by the computer manufacturer.
4. The translated program is punched into cards or written on magnetic tape or magnetic disk and may be read and stored in the computer at any time.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Review BCD
2. Review basic machine-language instructions.
3. Review concepts of problem-oriented programming languages.

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss differences between machine-languages and problem-oriented languages.
2. Develop procedural flow charts for problems which involve decision steps.

PROGRAM 9

PUTTING THE COMPUTER TO WORK

This program illustrates the steps involved in writing a program.

PROGRAM CONTENT

The major steps in writing a program to handle an hourly payroll application are illustrated in this program. First, a systems flow chart is developed to depict the various input and output files that are involved. Then a procedural flow chart is developed illustrating the sequence of operations the computer performs in order to compute the payroll data for each employee. The COBOL instructions required to perform the operations illustrated in the procedural flow chart are also described. The COBOL source program is keypunched and then compiled, creating a payroll object program. The payroll object program is read and stored in the computer's memory. The payroll data is then processed, an employee master file is updated, and cheques are written on the printer.

In order to clarify the payroll operation, a computer model is used to depict the storage of the payroll data, the arithmetic and logic operations involved, and the writing of the payroll cheques.

The program concludes with a detailed review of the payroll operation being processed on the computer system.

POINTS OF EMPHASIS

1. The output requirements of each application must be clearly defined.
2. Systems and procedural flow charts are integral aspects of any application.
3. A program, once written, should be thoroughly tested as to its completeness and logic.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Review general procedure to handle an hourly payroll.
2. Review functions of systems and procedural flow charts.

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss the advantages of a problem-oriented language such as COBOL.
2. Develop a systems and a procedural flow chart for an hourly payroll application.
3. Develop additional procedural steps that would be useful in proving the overall accuracy of the payroll application.

PROGRAM 10

THE CYBERNETIC AGE

This program, the last of a series of ten programs, examines some of the ways in which our lives today are affected by computers.

PROGRAM CONTENT

Cybernetics is the science of control and communication in all of its various manifestations in machines, animals and, organizations.*

By 1970, it is estimated that there will be twice as many computers installed in Canada as there were at the beginning of 1967. Computers have become a household word. People no longer have the apprehension they once had about computers taking over their jobs and watching their every move.

The uses of computers can generally be classified under one of the following — control, design, and simulation. Control applications which are illustrated include — computer control of traffic lights, rocket and satellite launchings, customer savings accounts, and MICR cheques (Magnetic Ink Character Recognition). A simulation application used by the Ontario Hydro illustrates alternative ways to route power during a blackout, and indicates the results which the real situation should produce. The increasing importance of data communication is also illustrated.

POINTS OF EMPHASIS

1. Everyone is affected by the increasing scope of computers.
2. The computer is a tool which increases man's capacity to discover, create, solve and think.
3. Through the computer, man is able to extend his power over his environment.

*McGRAW-HILL *Encyclopedia of Science and Technology, v. 3, p. 637.* McGraw-Hill Inc. 1960, 1966.

BUSINESS AND COMMERCE – Intermediate & Senior Divisions
DATA PROCESSING
10 programs, 20 minutes each

Prog. No.	CBC 9:45-10:05	CBLT 9:40-10:00	CHCH 9:25-9:45	CKCO 9:30-9:50	CJOH 9:40-10:00	CKLW 10:40-11:00
1	OCT. 21 – 9:40-10:00	OCT. 21	OCT. 21 – 9:10-9:30	OCT. 23 – 10:10-10:30	OCT. 21	OCT. 30
2	NOV. 4	NOV. 18	NOV. 4 – 9:10-9:30	NOV. 6 – 10:10-10:30	OCT. 28	NOV. 13
3	NOV. 18	DEC. 2	NOV. 18 – 9:45-10:05	NOV. 18 – 9:50-10:10	NOV. 18	NOV. 25 – 10:20-10:40
4	DEC. 9	DEC. 16	DEC. 9 – 9:30-9:50	DEC. 16	DEC. 9 – 9:15-9:35	JAN. 6 – 10:00-10:20
5	JAN. 6 – 9:40-10:00	JAN. 20 – 10:00-10:20	JAN. 13 JAN. 14 – 9:30-9:50	JAN. 7 – 9:50-10:10	JAN. 6	JAN. 14
6	JAN. 27 – 9:40-10:00	FEB. 17 – 10:10-10:30	FEB. 3 FEB. 4 – 9:30-9:50	JAN. 28 – 9:50-10:10	FEB. 3	FEB. 4 – 10:20-10:40
7	FEB. 17	MAR. 10 – 9:55-10:15	MAR. 24	FEB. 25	MAR. 3 – 9:20-9:40	MAR. 4– 10:00-10:20
8	MAR. 10	MAR. 24	MAR. 31	MAR. 11	MAR. 24 – 9:10-9:30	MAR. 25 – 10:00-10:20
9	APR. 14	MAR. 31	APR. 14	MAR. 25	APR. 14 – 9:10-9:30	APR. 1– 10:00-10:20
10	MAY 12	APR. 28	APR. 28	APR. 29	MAY 12 – 9:20-9:40	MAY 6 – 10:00-10:20

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